The following page fault numbers include the initial loading into memory for $\mathrm{A}, \mathrm{B}, \mathrm{C}$ (compulsory miss)

FIFO

| $P$ | $A$ | $B$ | $C$ | $D$ | $D$ | $E$ | $E$ | $C$ | $B$ | $A$ | $D$ | $E$ | $C$ | $B$ | $A$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | $A$ |  |  | $D$ |  |  |  |  |  | $A$ |  |  | $C$ |  |  |
| 2 |  | $B$ |  |  |  | $E$ |  |  |  |  | $D$ |  |  | $B$ |  |
| 3 |  |  | $C$ |  |  |  |  |  | $B$ |  |  | $E$ |  |  | $A$ |

12 Page Faults in total
MIN

| $P$ | $A$ | $B$ | C | D | D | E | E | C | B | $A$ | $D$ | $E$ | $C$ | $B$ | $A$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | A |  |  | D |  | E |  |  |  |  |  |  |  | $B$ | $A$ |
| 2 |  | B |  |  |  |  |  |  |  | $A$ | $D$ |  |  |  |  |
| 3 |  |  | C |  |  |  |  |  |  |  |  |  |  |  |  |

9 Page Faults in total, the last two page faults could choose to replace any physical page. LRU

| $P$ | $A$ | $B$ | $C$ | $D$ | $D$ | $E$ | $E$ | $C$ | $B$ | $A$ | $D$ | $E$ | $C$ | $B$ | $A$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | $A$ |  |  | $D$ |  |  |  |  | $B$ |  |  | $E$ |  |  | $A$ |
| 2 |  | $B$ |  |  |  | $E$ |  |  |  | $A$ |  |  | $C$ |  |  |
| 3 |  |  | $C$ |  |  |  |  |  |  |  | $D$ |  |  | $B$ |  |

12 Page Faults in total.
CLOCK

| $P$ | $A$ | $B$ | $C$ | $D$ | $B$ | $A$ | $E$ | $F$ | $B$ | $F$ | $A$ | $G$ | $E$ | $F$ | $A$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | $A$ |  |  |  |  |  |  |  |  |  |  |  | $E$ |  |  |
| 2 |  | B |  |  |  |  |  |  |  |  |  |  |  |  | $A$ |
| 3 |  |  | C |  |  |  | E |  |  |  |  | G |  |  |  |
| 4 |  |  |  | D |  |  |  | $F$ |  |  |  |  |  |  |  |

9 Page Faults in total.
Initially when every slot is empty, A-D are filled in slot 1-4.
At this point, clock hand is pointing at 1 , with all slots' read flag off.
Next, reading B, A, turns on slot 1 and 2's read flag.
Clock looks like this. (H indicates hand position)
H

| 1 | 2 | 3 | 4 |
| :--- | :--- | :--- | :--- |
| $R$ | $R$ | $N$ | $N$ |

E comes next, need to replace something. Clock hand looks at slot 1 and 2, skips them both, since they have read flag on, clears the read flag. replaces C with E. Now clock looks like this.

|  |  |  | H |
| :--- | :--- | :--- | :--- |
| 1 | 2 | 3 | 4 |
| N | N | N | N |

F comes next, replace D with F.
H
$\begin{array}{llll}1 & 2 & 3 & 4 \\ \mathrm{~N} & \mathrm{~N} & \mathrm{~N} & \end{array}$
$\mathrm{N} \quad \mathrm{N} \quad \mathrm{N} N$
Read B, F, A, mark slot $1,2,4$ as read.
H
$\begin{array}{llll}1 & 2 & 3 & 4\end{array}$
R R N R
G comes, need to replace. Hand moves from 1 to 3 , replaces slot 3 with G, clears 1,2. Hand points to slot 4 .

|  |  |  | H |
| :--- | :--- | :--- | :--- |
| 1 | 2 | 3 | 4 |
| N | N | N | R |

E comes, need to replace. clears $R$ flag on slot 4 , replaces slot 1 .

|  | H |  |  |
| :--- | :--- | :--- | :--- |
|  | 2 | 3 | 4 |
| N | N | N | N |

Read F, mark slot 4 R flag.
A comes, replace slot 2.
Clock looks like this at the end.

|  |  | $H$ |  |
| :--- | :--- | :--- | :--- |
| 1 | 2 | 3 | 4 |
| N | N | N | R |

